

Introductory Astronomy

Homework 26: The Discovery of Galaxies Not to be handed in. Homework solutions are posted already.

044 qmult 00100 1 4 4 easy deducto-memory: galaxy defined

Extra keywords: CK-370

1. “Let’s play *Jeopardy!* For \$100, the answer is: They are large, gravitationally-bound systems of stars that range from dwarf versions that are kiloparsec in size scale to the large ones that are tens of kiloparsecs in size scale.”

What are _____, Alex?

- a) binaries b) open clusters c) globular clusters d) galaxies e) universes

SUGGESTED ANSWER: (d)

Wrong answers:

- a) Now does this sound likely?

Redaction: Jeffery, 2001jan01

044 qmult 00200 1 4 4 easy deducto-memory: traditional Milky Way

Extra keywords: CK-370

2. “Let’s play *Jeopardy!* For \$100, the answer is: In the celestial-sphere picture of the sky, this object is luminous band on celestial sphere that straddles a great circle that is at an angle of about 60° to the celestial equator.”

What is the _____, Alex?

- a) Zodiac b) celestial axis c) ecliptic d) Milky Way e) Andromeda Nebula

SUGGESTED ANSWER: (d) See CM-366 for the angle of the Milky Way band on the celestial sphere.

Wrong answers:

- a) The Zodiac constellations straddle the ecliptic.

Redaction: Jeffery, 2001jan01

044 qmult 00210 2 1 2 moderate memory: center of Milky Way

3. The center of the Milky Way is in:

- a) Orion. b) Sagittarius. c) Virgo. d) Cassiopeia. e) Norma.

SUGGESTED ANSWER: (b)

Wrong answers:

- e) Norma is a small constellation in the southern celestial sphere. No one knows the Norma myth.

Redaction: Jeffery, 2001jan01

044 qmult 00310 1 1 1 easy memory: Milk Way stars

4. Democritus (460?–360? BCE) hypothesized that the Milky Way was made of stars unresolvable to the unaided eye. Galileo and other observers of circa 1610 verified this hypothesis using the then recently invented:

- a) telescope. b) microscope. c) spectroscope. d) astrolabe. e) sundial.

SUGGESTED ANSWER: (a)

Wrong answers:

- e) An astrolabe is combination map of sky and star position measuring device. In primitive form it may have been invented by Hipparchos (2nd century BC) (No-96). Geoffrey Chaucer (1343?–1400) wrote at treatise on astrolabe (No-214).
 e) As Lurch would say: “Aaaarh.”

Redaction: Jeffery, 2001jan01

044 qmult 00330 1 4 4 easy deducto-memory: Herschel maps the Milky Way

5. “Let’s play *Jeopardy!* For \$100, the answer is: He/she attempted to map the Milky Way using star counts (or star gauges).”

Who is _____, Alex?

- a) Nicolaus Copernicus (1473–1543) b) Galileo Galilei (1564–1642) c) Isaac Newton (1642/3–1727)
 d) William Herschel (1738–1822) e) Caroline Lucretia Herschel (1750–1848).

SUGGESTED ANSWER: (d)

Wrong answers:

- c) Newton was born 1642dec25 on the Julian calendar used in England all of this life. This 1643jan04 on the modern Gregorian calendar that was used in most of the rest of Europe at that time.
 e) She was probably nearby making coffee or something. Actually, she helped her brother a lot.

Redaction: Jeffery, 2001jan01

044 qmult 00350 1 4 3 easy deducto-memory: Shapley and Milky Way

6. “Let’s play *Jeopardy!* For \$100, the answer is: He/she obtained the first roughly correct size estimate for Milky Way using Cepheid variable stars in globular clusters in the halo of the Milky Way.”

Who is _____, Alex?

- a) Henrietta Swan Leavitt (1868–1921). b) Heber Curtis (1872–1942). c) Harlow Shapley (1885–1972).
 d) Edwin Hubble (1889–1953). e) Stephen Hawking (1942–).

SUGGESTED ANSWER: (c)

Wrong answers:

- a) She was the discoverer of the period-luminosity relation for Cepheid variable stars (No-488) while working at Harvard College Observatory. Distance determinations by Hubble using this relation established the extragalactic nature of the galaxies.

Redaction: Jeffery, 2001jan01

044 qmult 00400 1 4 4 easy deducto-memory: nebulae

Extra keywords: CK-366,370

7. Clouds in space or, historically, those objects regarded as cloud-like are called:

- a) shapleys. b) stars. c) galaxies. d) nebulae. e) curtises.

SUGGESTED ANSWER: (d)

Wrong answers:

e) As Lurch would say: “Aaaarh.”

Redaction: Jeffery, 2001jan01

044 qmult 00460 1 4 2 easy deducto-memory: Rosse discovers spirals

Extra keywords: CK-366, super-easy deduction question

8. The spiral nature of some nebulae was discovered using visual astronomy and the largest telescope of its time: the 183-cm diameter Leviathan of Parsonstown located at Birr Castle, Parsonstown, Ireland. Because the spiral nebulae are rather faint, it takes a large telescope to make out the spiral arms visually. With long-exposure photography it is relatively easy to discover spirals. But visual astronomy beat the recently invented photography by some years in this case: the discovery was made in 1845 April by the builder of the Leviathan:

a) Henrietta Swan Leavitt (1868–1921). b) the Earl of Rosse (1800-1867). c) Edwin Hubble (1889–1953).
 d) Harlow Shapley (1885–1972). e) Caroline Lucretia Herschel (1750–1848).

SUGGESTED ANSWER: (b)

Wrong answers:

e) Yes, 95-year old Caroline Herschel still going strong in Ireland ...

Redaction: Jeffery, 2001jan01

044 qmult 00500 1 1 4 easy memory: Shapley-Curtis debate

Extra keywords: CK-370

9. On 1920 April 26, a debate about the nature of the spiral nebulae was held at a meeting of the National Academy of Sciences in Washington, D.C. The debaters both made sound points in the printed presentations that they later made if not on the day of. This debate is called the Great Debate or the:

a) Einstein-de Sitter debate. b) Rosse-Hubble debate. c) Shapley-Hubble debate.
 d) Shapley-Curtis debate. e) Kant-Einstein debate.

SUGGESTED ANSWER: (d) Curtis is generally considered to have won on actual points on the day of since Shapley was aiming at impressing people who could hire him to be director of the Harvard College Observatory than on winning the debate. Curtis also won historically: he argued the spiral nebulae were other galaxies and he was right. See Hoskin, M. A. 1976, *Journal for the History of Astronomy*, vii, 169.

Wrong answers:

e) It might have been interesting to have Immanuel Kant (1724–1804) square off with Albert Einstein (1879–1955).

Redaction: Jeffery, 2001jan01

044 qmult 00610 1 4 2 easy memory: Hubble and the 100-inch

10. Edwin Hubble (1889–1953) was able to prove the extragalactic nature of the spiral nebulae because, among other things, he had available the world's:

a) largest telescope of our day. b) largest telescope of his day. c) smallest telescope of his day.
 d) smallest telescope of our day. e) largest telescope of Newton's day.

SUGGESTED ANSWER: (b)

Wrong answers:

- a) The Hooker 100-inch (2.54 m) telescope is a significant, but not large, telescope by modern standards.
- e) As Lurch would say: "Aaaarh."

Redaction: Jeffery, 2001jan01